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BULLETIN No. 2. A. S. 4.

U. S. DEPARTMENT OF AGRICULTURE.

DIVISION OF AGRICULTURAL SOILS.

SOIL MOISTURE.

A RECORD OF

THE AMOUNT OF WATER CONTAINED IN SOILS

DURING THE

MONTH OF JUNE, 1895.

WASHINGTON:

GOVERNMENT PRINTING OFFICE.

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LETTER OF TRANSMITTAL.

U. S. DEPARTMENT OF AGRICULTURE,
DIVISION OF AGRICULTURAL SOILS,
Washington, D. C., September 16, 1895.

SIR: I have the honor to transmit herewith data showing the amount of moisture in the soils of a number of localities in the United States during the month of June, together with brief notes as to the character of the season and the crop conditions.

Very few reliable deductions can be made from observations extending over a single season, especially as the methods and object of the work were new to most of our observers. The information is therefore presented in a graphic way with but little criticism or comment.

Respectfully,

MILTON WHITNEY,
Chief of Division.

Hon. J. STERLING MORTON,
Secretary of Agriculture.

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THE WATER CONTENT OF SOILS DURING THE MONTH OF JUNE.

SUMMARY OF CONDITIONS DURING THE MONTH OF MAY.

The object of this work and the method used in keeping a record of the amount of moisture in soils has been briefly referred to in Bulletin No. 1 of this Division, which also contained statements showing the actual moisture conditions of the soils during the month of May. The conditions during that month may be briefly summarized as follows:

In the Eastern States the observers in the truck, tobacco, and grass regions reported generally very favorable soil conditions for the growing crops. In Kansas and Nebraska, on the other hand, the season was reported as extremely dry, little or no rain having fallen at most of the localities during the month, and but little for several months previous. The records showed that under these extremely dry conditions in many of the soils cultivation had maintained considerably more moisture in the first 12 inches than was found under the natural prairie sod. The grass had been an enormous drain upon the soil moisture, and had reduced the amount to about one-half of that contained in the cultivated land upon which no crop was allowed to grow. The amount of moisture in the fields under ordinary cultivation was still several per cent below the water content of the irrigated fields. In other localities, notably at Wellington, Stafford, and Mankato, Kans., cultivation appeared to have very little influence upon the amount of water in the soil during this dry season. It must be remembered that cultivation in itself does not make a soil more moist, but simply prevents the soil from drying out by retarding the excessive evaporation of the water from the surface. If, therefore, the soil is allowed to become dry, it is not to be expected that subsequent cultivation will make the soil materially wetter.

For the same reason the subsoiled plats from which the samples were taken showed little or no increase, and in many cases decidedly less water than the amount in the soil under ordinary cultivation. It was explained at the time that with one exception the subsoiling had been done in a very dry season and immediately before the observations

were begun, so it could not be expected that these fields would show a larger water content. At one station in Nebraska subsoiling had been done some time before the observations were commenced and there had been subsequent rains; the amount of moisture in the subsoiled field was considerably more than in that under ordinary cultivation.

THE CONDITIONS DURING THE MONTH OF JUNE.

The conditions prevailing during the month of June are the reverse of those which occurred during the previous month. In the Eastern States the observers in the truck, tobacco, and grass regions reported the conditions rather too dry for the respective crops, at least during the middle and latter part of the month; the observers in Kansas and Nebraska, on the contrary, reported exceedingly favorable conditions of moisture. The rainfall was abundant and well distributed in showers occurring at intervals of a week or ten days. The observer at Garden City, Kans., reports that the season was so extremely favorable that no irrigation was needed during the month. At several of the other stations irrigation was not needed, except for a dry period beginning about the 20th and lasting for eight or nine days. Throughout the month, most of the observers reported crops in a very flourishing condition, with a good prospect for a fine corn crop. Some of the wheat also, which it was feared would be a total failure, took a fresh start under these favorable conditions and matured a fair crop in many localities, ripening a month later than usual. Many of the spring-planted crops were not planted under dry farming until after the rain of May 30 to June 2.

THE REPORTS FOR THE MONTH OF JUNE.

The data from Toano, Va., are from a typical truck land. Similar records from Maryland during this month show about the same conditions, and a normal water content of these truck soils appears to be between 5 and 10 per cent, the latter being rather too moist and the former rather too dry for the best development of the truck crops.

The data from the three types of tobacco land, including the bright tobacco, the dark shipping tobacco, and the white burley tobacco, appear to show characteristic conditions necessary for the proper development of these three classes of tobacco.

The moisture conditions most favorable to the bright tobacco appear to range from 6 to 8 per cent, 10 per cent making the soil rather too wet, while with only 5 per cent of moisture the soil is rather too dry. The dark shipping tobacco land has maintained on an average about 15 per cent of water, ranging from about 13 to 17 per cent. These conditions were reported as generally favorable to the crop. The soil adapted to the white burley tobacco maintained on an average about 20 per cent, and varied only from 19 to 21 per cent throughout the month. The conditions here also were reported as generally favorable

to this crop. These marked differences in the amount of water contained in these three types of land appear to be very characteristic and to give the different soils their peculiar value for these crops. The bright tobacco soil can not maintain, under the conditions which prevail, as much water as the dark tobacco soil, but if the amount was materially larger than that shown by the records for this month, the crop would have partaken of the nature of the dark tobacco plants.

The records from Lexington, Ky., show that the grass in the sod land was an enormous drain upon the moisture. The supply of water was reduced to one-half that contained in the adjoining plat from which the sod had been removed, but which had been left without subsequent cultivation. The records further show the minimum or danger point at which pastures suffer in this land. On June 9, with 12 per cent of moisture in the soil of the sod land, the conditions were reported as very dry and rain as badly needed. After this the water content fell to 10 per cent by the 14th, which was several per cent less than the amount the crop required.

The conditions at Greendale, Ky., were very similar to those at Lexington, except that there were a number of local showers. Here again it is apparent that the grass was a very great drain upon the soil moisture, reducing the amount to 11 per cent, which indicates a very severe drought for that locality.

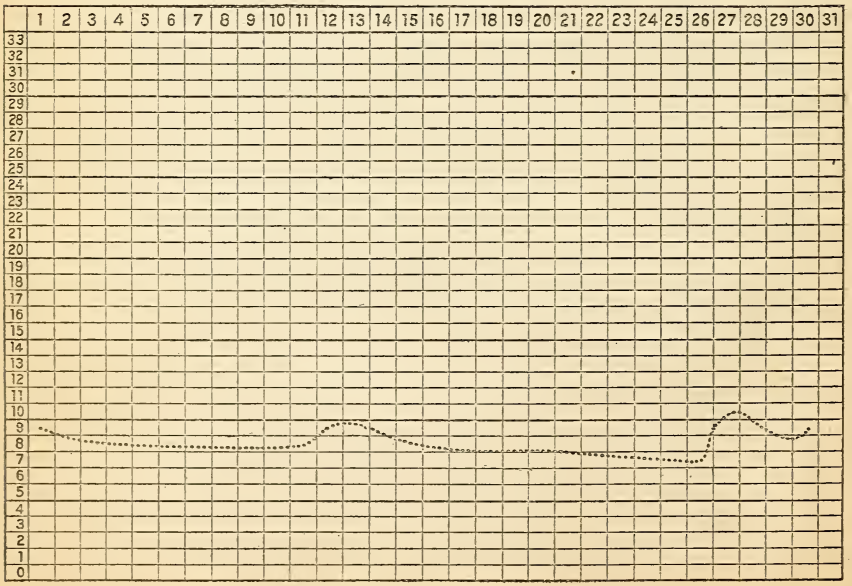
The records showing the conditions in the West are all commented upon directly under the diagrams. As a rule, during this favorable season the fields under ordinary cultivation and those which had been subsoiled and subsequently cultivated do not show very different moisture conditions. In some places the effect of cultivation is not apparent upon the moisture content of soils. For reasons which have already been given it is not to be expected that cultivation would show a very marked effect upon the amount of moisture in the soil either in a very dry season or in a very favorable season with frequent rains. The time when it would have its maximum effect would be after a wet season and when a dry period was coming on. The moisture content at this time should fall much more gradually in the cultivated than in the uncultivated land. This is shown to a slight extent in some of the records, but not to such an extent as would seem likely to occur under the most intelligent cultivation of the soil. The small amount of data which has been collected is not sufficient, however, to warrant a close and final judgment in this matter.

WHAT THE DIAGRAMS MEAN.

In the illustrations the vertical columns mark the days of the month, as indicated by the figures at the top of the diagram. The horizontal lines running across the diagram represent the percentage of moisture in the soil, as indicated in the column of figures on the left-hand side of the illustration, extending from 0 to 33 per cent. As a guide to the eye, the lines representing every 5 per cent of moisture are made heavier.

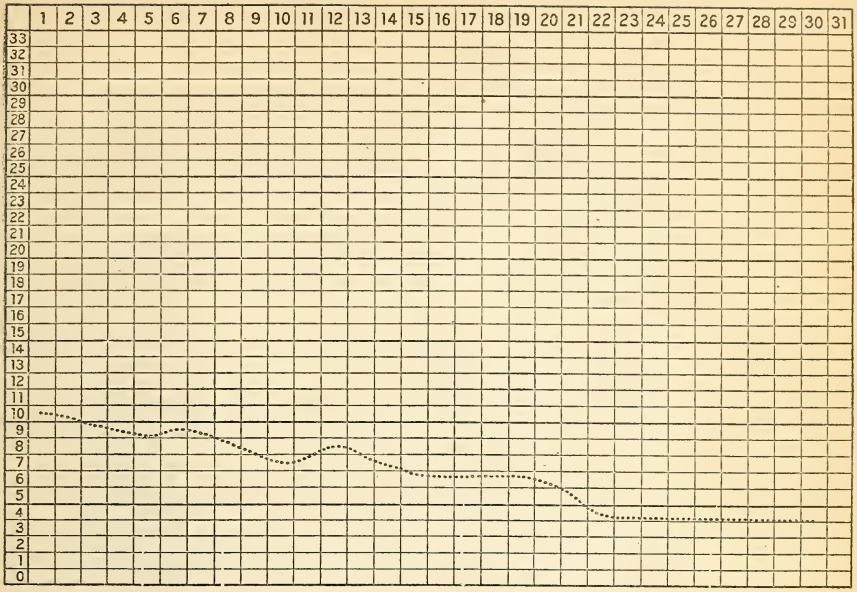
The records for each day of the month are put upon the form in their appropriate places. Thus, if on the 1st day of the month there is 8 per cent of moisture in the soil, a mark is placed in the column representing that day at a height corresponding to the figure 8 on the left-hand side of the page. If on the next day there is 12 per cent of moisture in the soil, a mark is made in the next column at a height corresponding with the figure 12, and so on for each day of the month. When these marks have all been placed, a permanent line is drawn through each of them, giving a more or less curved line according to the daily differences in the water contained in the soil. The marks are then rubbed out, and the curved line shows the monthly record. Where it is stated that there is 10 per cent of moisture in the soil, it means that on that date 10 per cent, or one-tenth of the weight of the soil in its natural position in the field to a depth of one foot from the surface, is water. When 20 per cent of water is present, it means that 20 per cent, or one-fifth of the weight of the soil as it lies in the field, is water. No crops were allowed to grow on any of the plats except two in sod land and four in prairie sod.

TOANO, VA.



Early truck land .....

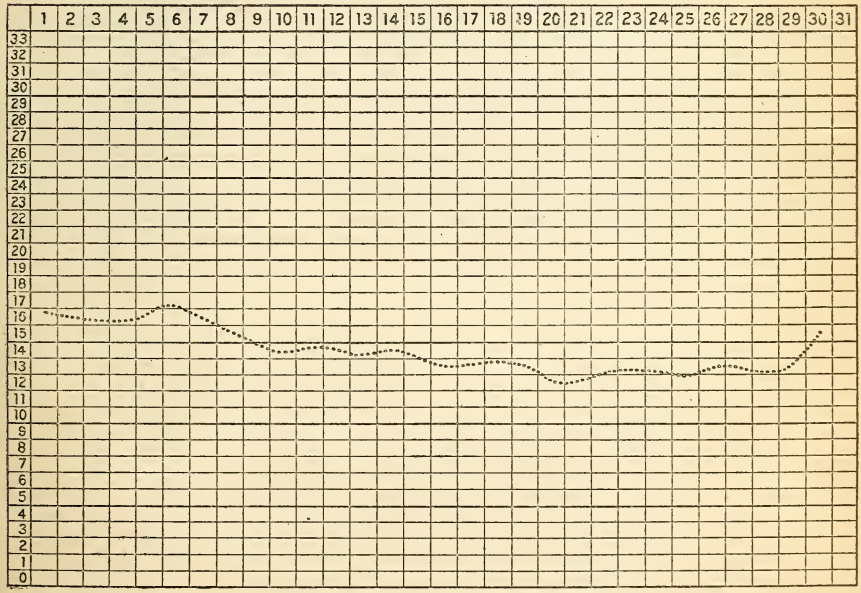
OXFORD, N. C.



Uncultivated bright tobacco land .....

Early part of month soil rather wet for growing crop; favorable for planting. Latter part of month soil rather too dry and rain needed.

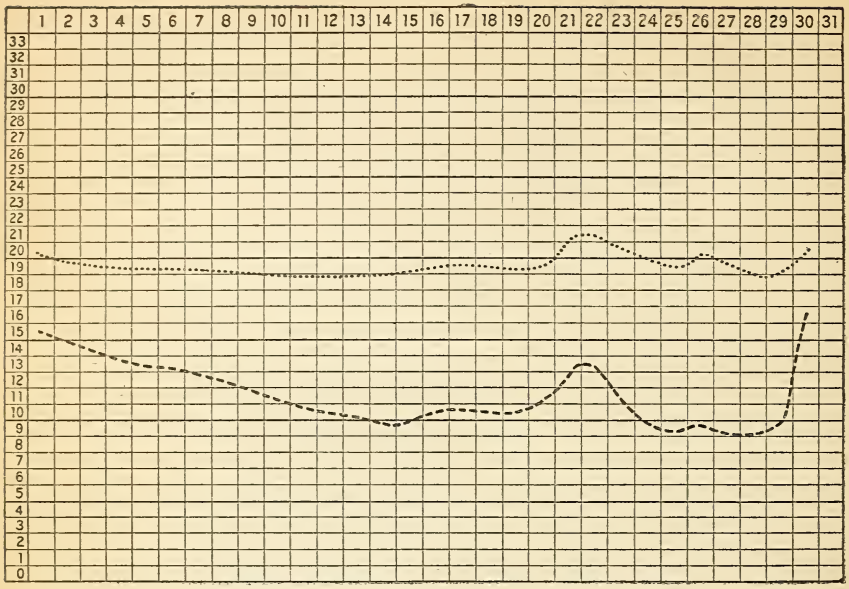
NEWSTEAD, KY.



Uncultivated shipping tobacco land .....

Up to middle of month soil condition reported as favorable for tobacco. Latter part of month reported rather dry. On June 10 crop reported as beginning to grow.

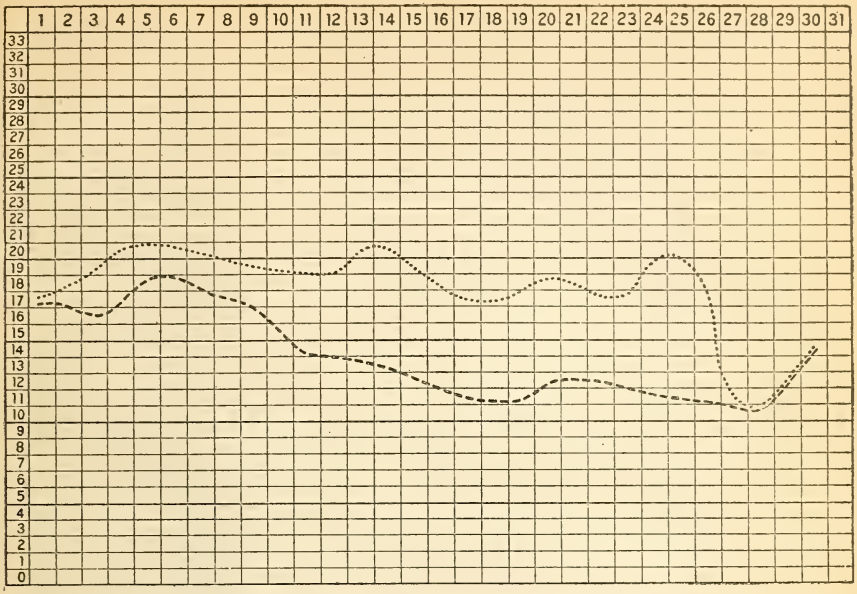
LEXINGTON, KY.



Uncultivated ..... Blue-grass sod ▬▬▬

The soil was reported as too dry throughout the month, except for a slight shower, which made the conditions of the surface favorable, on June 4 to 6, and rain on the 20th, the effects of which were not apparent after June 22. On the 30th there was a heavy rain which made the soil too wet for a time. During the latter part of the month of May when the season was very favorable there was very little difference in the water content of the uncultivated and of the sod land. It can be seen from these curves that during the month of June the grass was an enormous drain upon the soil moisture. It diminished the amount of water to one-half of that contained in the uncultivated, reducing the amount from about 20 per cent to about 10 per cent. When the soil under the grass sod to a depth of 1 foot contained as little as 10 or 12 per cent of moisture, it was insufficient for this kind of vegetation. On June 27 the observer reported that the pasture was about dried up. The following notes were supplied by the observer: June 5, rain in the early morning, clear in the afternoon. Good season for tobacco planting. On the uncultivated soil, owing to the previous dry condition of the surface, the rain has been rapidly absorbed, the ground is drying out fast. June 9, hot and dry, rain badly needed. June 10, hot and dry, with dry winds. Grass burning up, crops need rain. From this time until June 15 hot, dry winds were reported. On June 15 there was a light local rain about noon which was rapidly absorbed. June 17 the surface seemed drier than before the rain of the 15th. On June 19 wheat harvesting began. On June 19 there was a light rain during the night and early morning followed by a cloudy day. June 25, dry winds. When sample was taken on June 26 the ground was slightly damp on the surface from showers in the afternoon. On June 28 the season was referred to as a severe drought, the ground being so hard at that time that it was difficult to drive the sampling tubes. On June 30 there was a heavy rain in the afternoon and water was standing on the surface when the sample was taken.

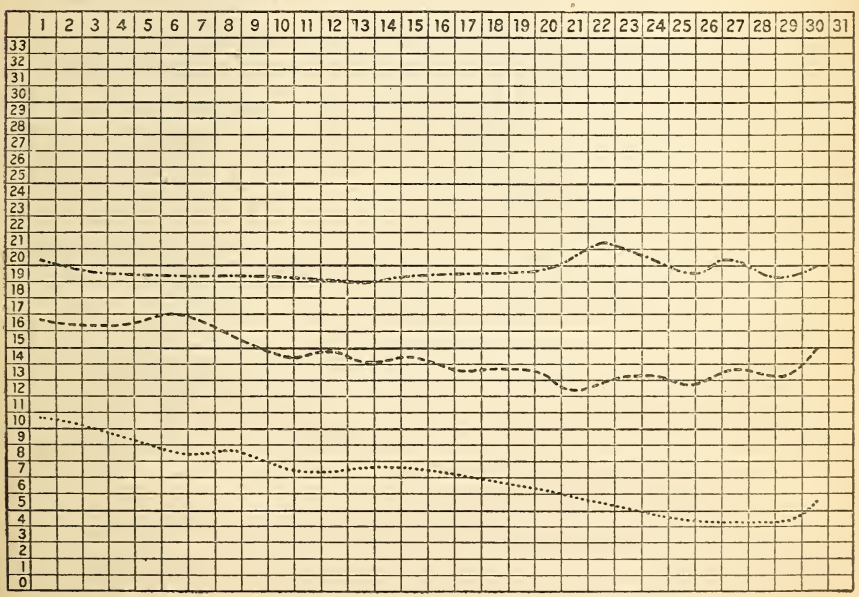
GREENDALE, KY.



Uncultivated ..... Blue-grass sod

Conditions were quite similar to those in Lexington, except that there were a number of local showers, which did the crops little good. Up to the middle of the month the crops were reported as fairly good. From the 17th to the last day of the month a severe drought was in progress and crops were reported as drying up.

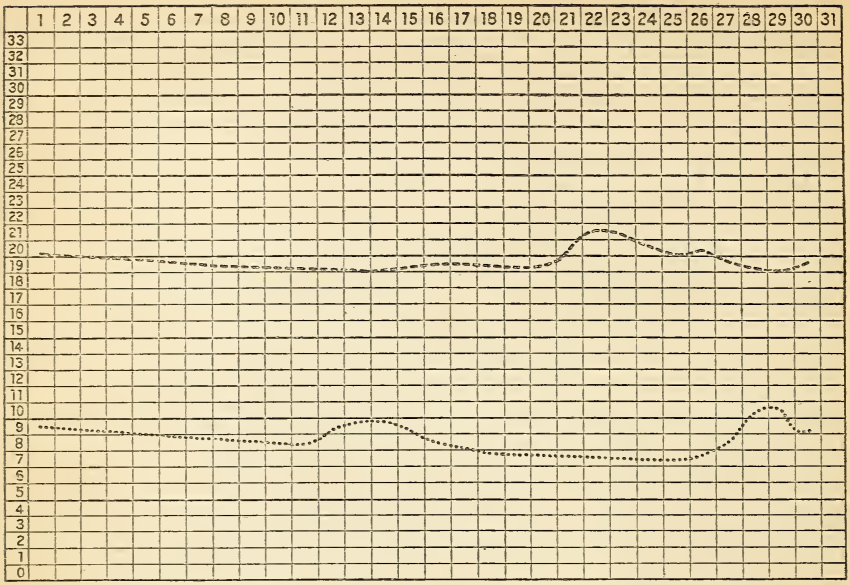
TYPES OF TOBACCO LAND.



Bright tobacco ..... Shipping tobacco White burley tobacco

These curves show characteristic differences in the soil conditions adapted to the three classes of tobacco. The first part of the month was reported as generally favorable in all three localities, while the latter part of the month was rather too dry, and crops suffered from lack of sufficient moisture. This comparison indicates marked differences in the conditions adapted to these classes of tobacco.

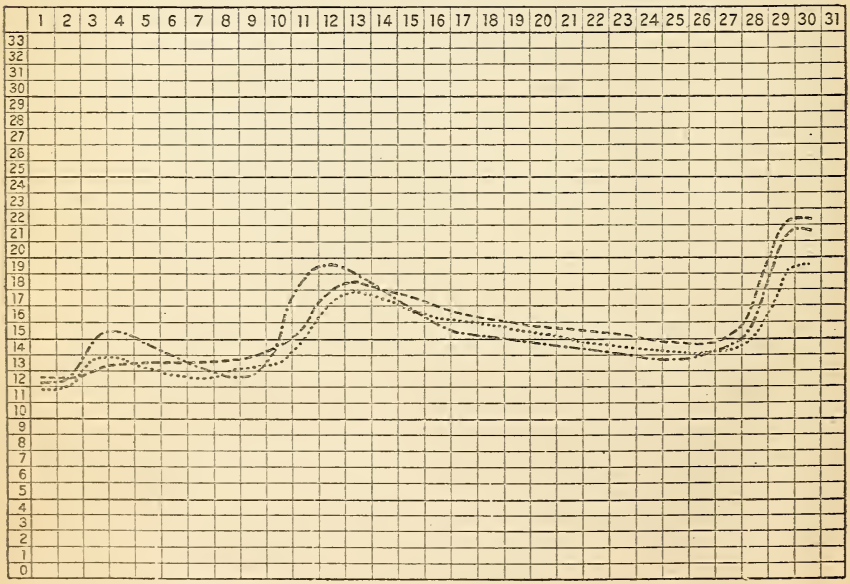
TYPES OF GRASS AND TRUCK LAND.



Early truck..... Grass land

These curves show the conditions in two extreme types of agricultural soils—truck and grass. If the curve here representing the conditions of moisture in the grass land represents the necessary conditions for that crop, it can readily be seen that the moisture conditions in the truck lands are entirely inadequate for grass. By referring to the chart showing the conditions at Lexington, Ky., it will be seen that when the soil under the grass sod contained even more moisture than is contained in the uncultivated truck land that the supply was inadequate for this crop and the pastures were drying up.

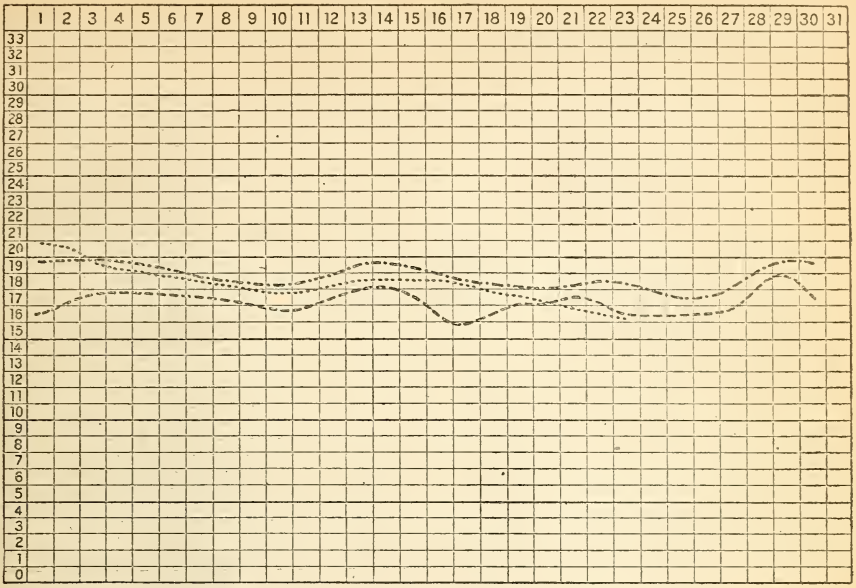
WELLINGTON, KANS.



Uncultivated ..... Cultivated Subsoiled

The soil conditions were generally favorable throughout the month. The dry season prevailing during the month of May was not broken until June 3. There were three rainfalls during the month of June, which kept the soil in good condition. The soil was reported as rather too dry for crops on the 1st, 8th, and 25th of the month and for a day or two before and after these dates. Neither subsoiling nor ordinary cultivation appears to have had any marked effect on the water content of the soil.

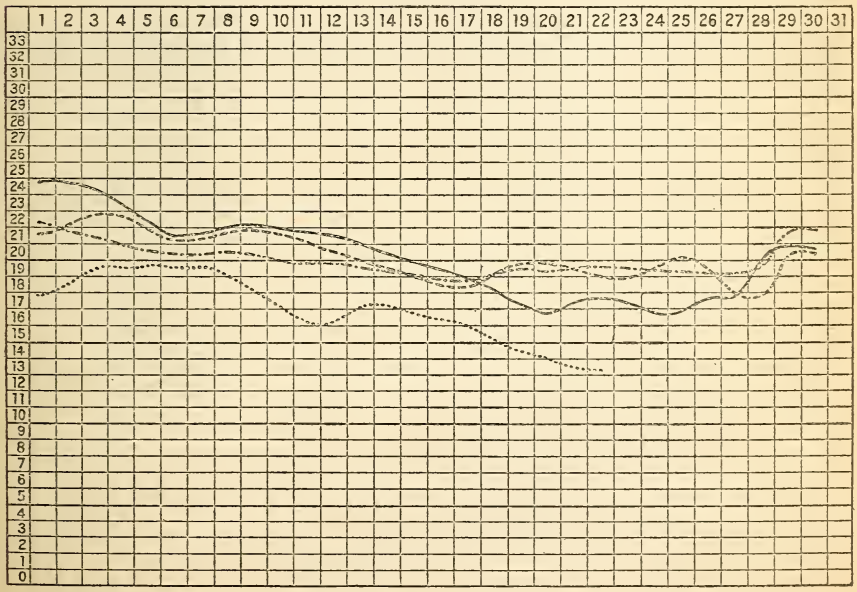
PHILLIPSBURG, KANS.



Uncultivated ..... Cultivated ▬▬ Subsoiled ▬▬

The soil conditions were reported favorable throughout the month; the heavy rain of May 30 put the ground in good condition after the long drought which had prevailed, and frequent rains throughout the month of June kept the soil in a favorable condition for the crops. The observer writes on June 15 that wheat was almost a total failure; potatoes, corn, and alfalfa were in good condition. Everything at that time growing nicely. No marked effect of cultivation or subsoiling is apparent from these records.

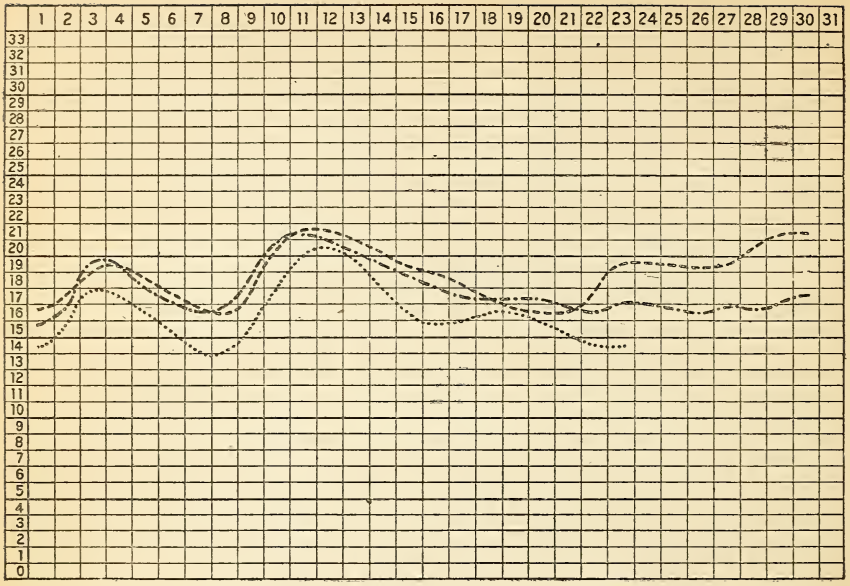
SCOTT, KANS.



Prairie sod ..... Cultivated ▬▬ Subsoiled ▬▬ Irrigated ▬▬

The soil conditions were generally favorable throughout the month, except on June 3 and 4, when the surface was rather too wet for crops. On account of the drought prevailing in May, crops were planted for dry farming during the first week of June.

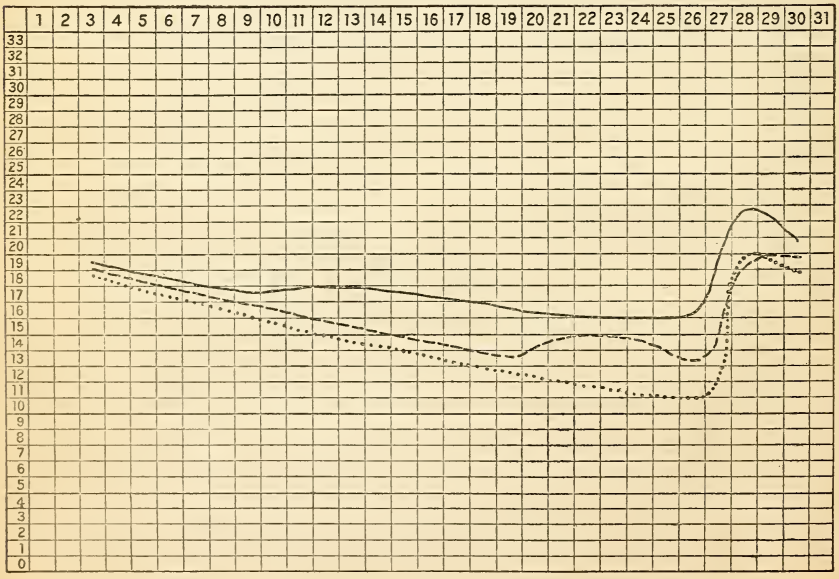
HAVEN, KANS.



Uncultivated ..... Cultivated ▬▬ Subsoiled ▬▬

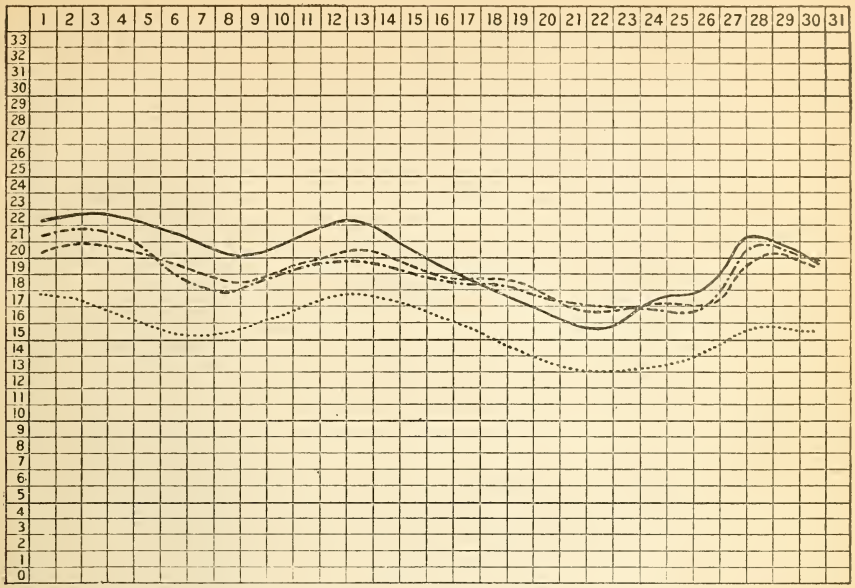
The soil conditions were reported as favorable throughout the month, except on June 3 and June 10 to 14, when they were reported as rather too wet. The moisture curves for the latter part of May show rather more moisture in the field under ordinary cultivation than in the subsoiled field. The records for June show very little difference between these two forms of cultivation. Nevertheless the observer wrote on June 15 that the crop in the adjoining subsoiled field was in much better condition than on the field under ordinary cultivation.

GARDEN CITY, KANS.



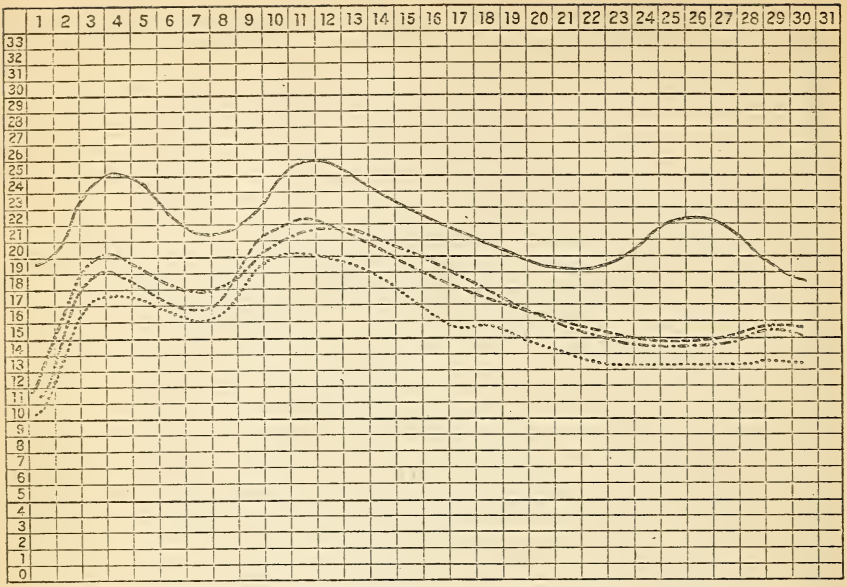
Prairie sod ..... Cultivated ▬▬ Irrigated ▬▬

COLBY, KANS.



The conditions were generally so favorable through the month that it was not necessary to irrigate the crops. Very little difference is seen in the moisture content in the plots under ordinary cultivation and the subsoiled land. They contained, however, from 2 to 4 per cent more moisture than the prairie sod. The following conditions were reported by the observer: About an inch of rain fell on June 9 to 12, and on June 14 fine growing weather was reported. On June 22 wheat and barley were reported headed out, but in need of rain. On June 24 hot winds prevailed, and the thermometer recorded 100° in the shade; small grains reported as suffering. Nearly an inch of rain fell June 27 and 28.

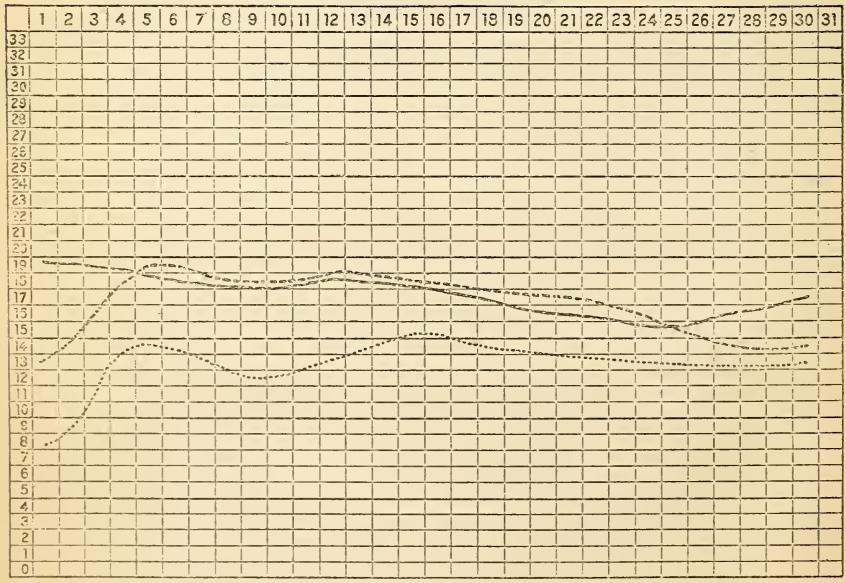
STAFFORD, KANS.



Uncultivated ..... Cultivated ═══ Subsoiled ═══ Irrigated ═══

The drought prevailing during the month of May ended with a copious rain on June 2. On June 1 the observer reported the crops had not been planted for dry farming, as the soil had been too dry. On irrigated land the soil was in good condition and crops were in bloom. The conditions continued generally favorable throughout the month. Very little difference was seen in the water content under subsoiled and ordinary cultivation.

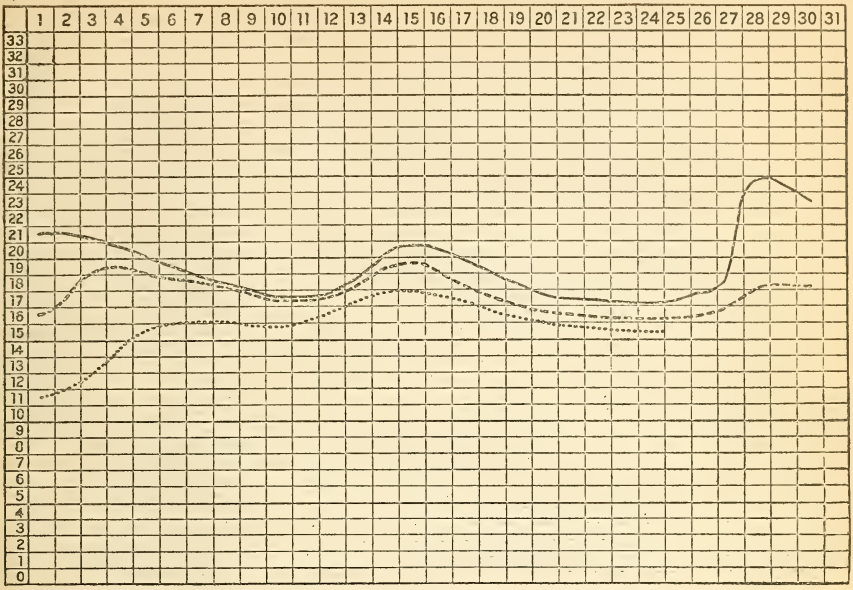
ELLINWOOD, KANS.



Prairie sod ..... Cultivated ═══ Irrigated ═══

The dry condition of the soil during the month of May was hardly affected by the rain of May 30, and on June 1 the soils were reported too dry. This was followed by copious rain, and conditions were reported generally favorable until June 23, when the temperature was exceedingly high and the crops were reported as suffering for water.

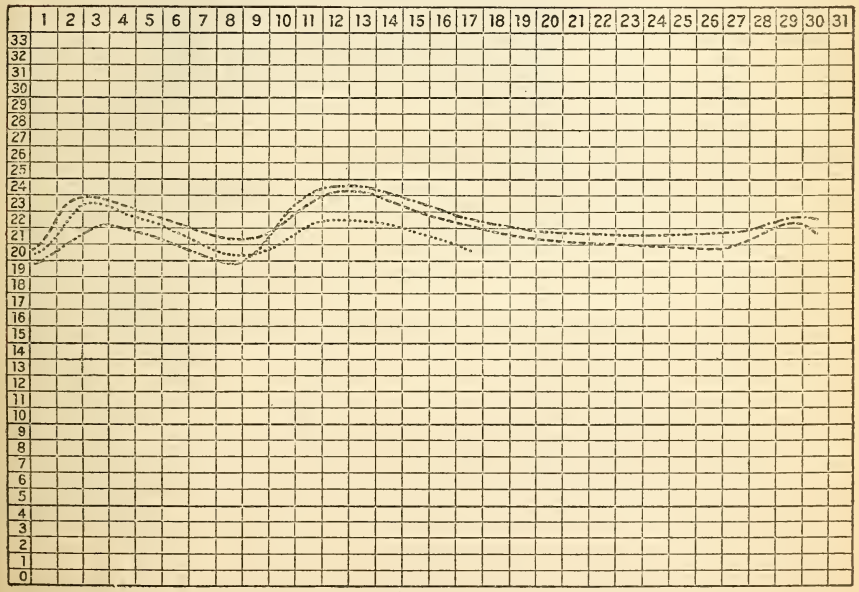
FOWLER, KANS.



Prairie sod ..... Cultivated ▬▬▬ Irrigated ▬▬▬

After the rain of May 30 and June 2 the soil conditions were very favorable except from June 8 to 11 and June 24 to 26, when it was reported as rather dry for crops.

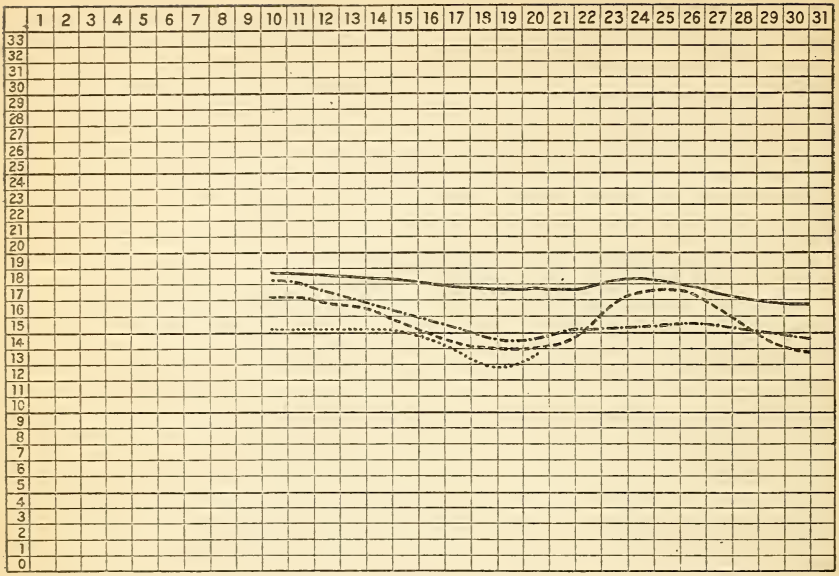
MANKATO, KANS.



Uncultivated ..... Cultivated ▬▬▬ Subsoiled ▬▬▬

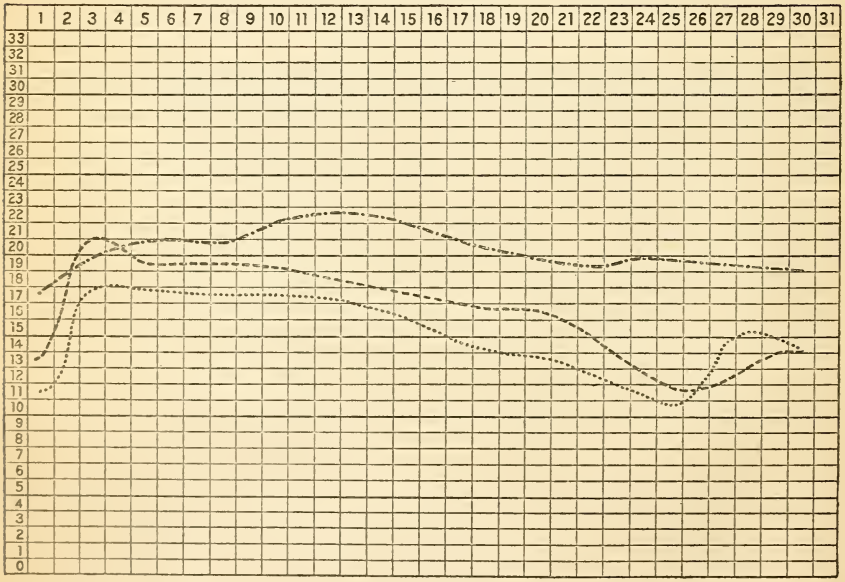
The observer at this point reports a hot moist month, with thrifty crops. June 21 and 22 the soil was reported as rather dry for oats and wheat, but favorable for corn. The average moisture content of this soil is much above that of the other stations in Kansas.

BIG SPRINGS, NEBR.



Uncultivated ..... Cultivated ▬▬▬ Subsoiled ▬·▬·▬ Irrigated ▬▬▬

GENEVA, NEBR.



Prairie sod ..... Cultivated ▬▬▬ Subsoiled ▬·▬·▬

This station (as noted in the May bulletin) is the only one at which the subsoiling was done a sufficient time prior to the taking of samples to insure a moistening of the soil as deep as stirred. Here the subsoiled plot shows a remarkably even curve—from 2 to 8 per cent higher than that under ordinary cultivation.